

CLAIMS

1. A tool used to hold an array of wafer scale protective caps and place the array onto a semiconductor wafer, the tool comprising:

5 a first tool half made from a semiconductor that has a coefficient of thermal expansion which is about the same as that of the wafer;
the first tool half having surface features for molding and retaining the array;
the caps having central areas surrounded by sidewalls.

- 10 2. The tool of claim 1, wherein:

the first tool half is made from silicon.

- 15 3. The tool of claim 1, wherein:

the first tool half is adapted to cooperate with a second half, the first tool half and the second half together forming a mold for the array.

4. The tool of claim 3, wherein:

the material is silicon.

5. The tool of claim 1, wherein:

20 the surface features of the first tool half have a spacing which corresponds to a spacing of the wafer.

6. The mold of claim 1, wherein:

the surface features are formed using cryogenic deep silicon etching techniques.

- 25 7. The mold of claim 3, wherein:

the first tool half has a lower surface in which recesses are formed;
the second half having an upper surface in which grooves are formed;
the recesses and grooves defining the mold cavities for the caps.

- 30 8. The tool of claim 1, wherein:

the first tool half includes first eject holes formed through it;

the holes located in registry with the surface features;
there being provided a first half release wafer from which projects a number of pins;

the pins located in registry with the first holes;

5 the first tool half having a thickness in the area of the first holes, the pins being longer than the thickness.

9. The tool of claim 8, wherein:

10 the first half release wafer has a first position in which the pins are flush with an interior end of the first holes;

there being a gap between the first half and the first half release wafer when the first half release wafer is in the first position.

10. The tool of claim 3, wherein:

15 the second half includes second holes formed through it;

there being provided a second half release wafer from which projects a number of pins;

the pins located in registry with the second holes;

20 the second half having a thickness in the area of the second holes, the pins being longer than the thickness.

11. The tool of claim 10, wherein:

25 the second half release wafer has a first position in which the pins are flush with an interior end of the second holes;

there being a second gap between the second half and the second half release wafer when the second half release wafer is in the first position.

12. The tool of claim 11, wherein:

30 the second holes are located in registry with grooves formed in an upper surface of the second half, the grooves being cap molding features.

13. The tool of claim 1, wherein:

the first tool half is comprised of a semiconductor that is transparent to infrared light of a wavelength of about 1000 -5000 nm.

14. The tool of claim 3, wherein:

5 the first tool half and second half are comprised of a semiconductor that is transparent to infrared light of a wavelength of about 1000 -5000 nm.

15. The tool of claim 3, wherein:

the first tool half includes first holes formed through it;

10 the holes located in registry with the surface features;

there being provided a first half release wafer from which projects a number of pins;

the pins located in registry with the first holes;

15 the first tool half having a thickness in the area of the first holes, the pins being longer than the thickness;

the first half release wafer having a first position in which the pins are flush with an interior end of the first holes;

there being a gap between the first tool half and the first half release wafer when the first half release wafer is in the first position; and

20 the second half includes second holes formed through it;

there being provided a second half release wafer from which projects a number of pins;

the pins located in registry with the second holes;

25 the second half having a thickness in the area of the second holes, the pins being longer than the thickness;

the second half release wafer having a first position in which the pins are flush with an interior end of the second holes;

there being a second gap between the second half and the second half release wafer when the second half release wafer is in the first position.

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16. The tool of claim 15, wherein:

the first and second halves and the first and second half release wafers are comprised of a semiconductor that is transparent to infrared light of a wavelength of about 1000 -5000 nm.

- 5 17. The tool of claim 3, wherein:
 the first half has first portions which separate adjacent surface features;
 the second half has cooperating and opposite second portions;
 the first and second portions coming together when the halves are brought together such that material is squeezed out from between the first and second portions,
10 separating adjacent caps.
18. The tool of claim 3, wherein:
 the first half has first portions which separate adjacent surface features;
 the second half has cooperating and opposite second portions;
15 the first and second portions coming together when the halves are brought together such that material is left as a thin layer between the first and second portions, the caps thus being formed as an array joined by the thin layer.
19. The tool of claim 1, wherein:
20 surface features are formed by electron beam or X-ray lithography.
20. The tool of claim 2, further comprising:
 a second mold half having an upper surface in which grooves are formed;
 the surface features of the first tool half and grooves defining the mold cavities for
25 the caps.